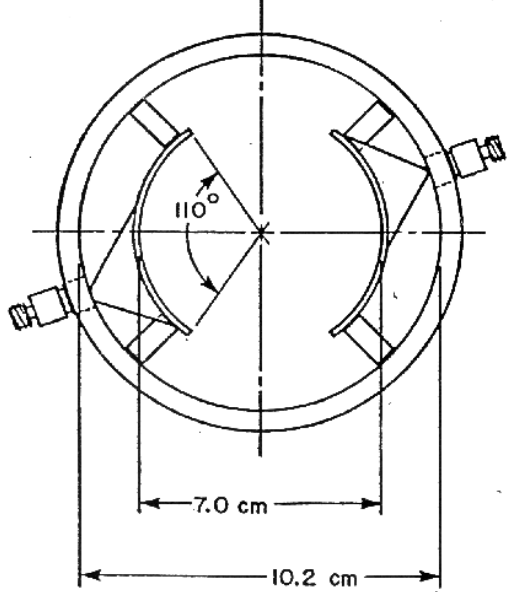


Tevatron BPM Upgrade

Stephen Wolbers

DOE Review

February 25, 2004

Organization of Tevatron BPM Upgrade Talks

- Steve Wolbers – Organization, Cost, Schedule, Effort, Plans
- Bob Webber – Technical Issues, Measurements

Outline of this talk

- Introduction/Project Scope
- Project Organization
- Cost, Schedule, Effort
- Installation and Commissioning
- Outstanding Issues

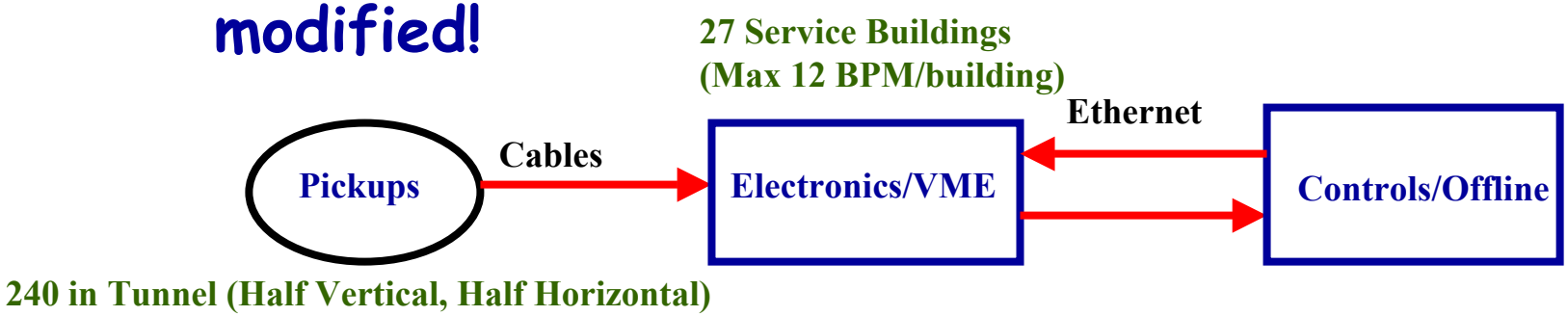
Project Definition

- The Tevatron BPM Upgrade Project will replace the current BPM electronics and the data acquisiton system used to transfer information between the BPMs and the Accelerator Controls Systems. As part of the project, the software used to read out, transfer, store, and analyze the BPM data will be upgraded. The goal of the project is to provide a BPM system based on modern hardware and software that gives the higher resolution and expanded functionality necessary to efficiently understand and operate the Tevatron Collider now and for the forseeable future. Deliverables of the project include all relevant documentation, manuals, users guides and any other written records necessary for maintaining the system.

  The project includes replacing the Tevatron BLM system interface hardware and software that is tightly coupled to the BPM system.

What is to be delivered by the project?

- All new electronics.
- Front-end software.
- Data to the online/controls system.
- Applications to use the new data.
- The pickups in the accelerator will not be modified!



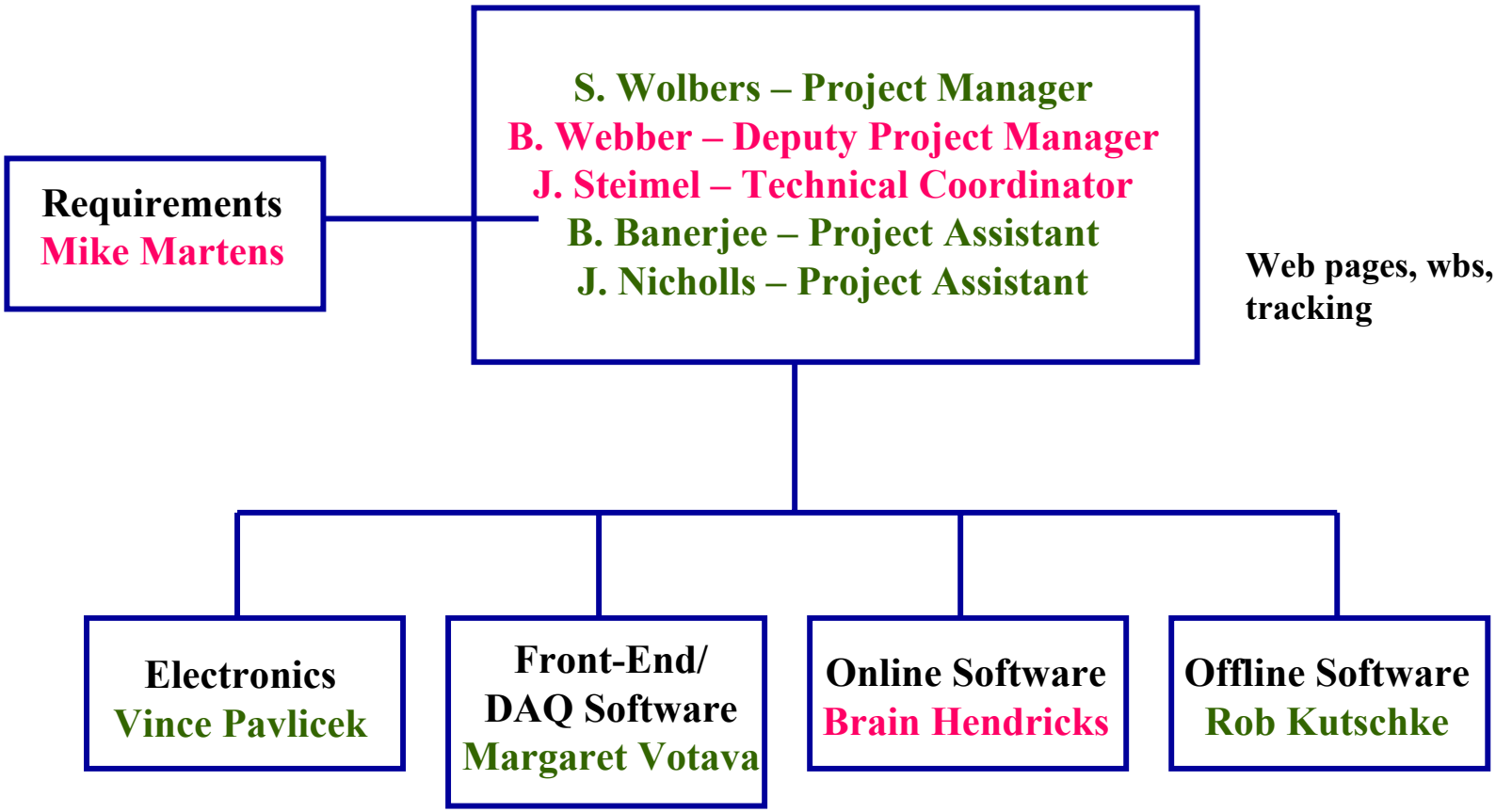
Scope of Project

- 240 BPMs (960 channels)
- 27 crates (max of 12 BPMs per service building)
- 2 test stands + 2 spares
- Timing/diagnostics system
- Calibration system
- Software (Front-end, online, offline)
- Specifications (Bob's talk)

Project management organization

- The project is a joint Accelerator Division/Computing Division project.
- Steve Wolbers is the project manager and Bob Webber is deputy project manager.
- Jim Steimel was appointed Technical Coordinator in January.
- The project office includes wbs, budget, tracking and web support

Tev BPM Upgrade Project Organization



+ CD/AD People Involved

- Mark Bowden, Bill Haynes, Luciano Piccoli, Dehong Zhang, Dinker Charak, Greg Duerling, Julia Yarba, Mark Fischler, Tom Boes, Mike Behnke, Bill Barker, Stu Bledsoe
- Marv Olson, Ken Koch, Brian Chase, Duane Voy, Jim Patrick, Al Baumbaugh, Judy Sabo, Jean Slaughter, Joel Butler, Stephen Pordes, Fritz DeJongh, Eric James

Project Planning

- A wbs has been developed for the project. There are 5 major "tasks" and 4 major subtasks in this structure.
- The wbs is effort loaded and contains all M&S and SWF.
- An important part of planning is the handoff to "operations" and the long-term support of the hardware and software developed as part of the project.
  - This is an acknowledged concern that we will address.

Major M&S Costs summary

- EchoTek boards (or equivalent): $1.08M
  (150: 124 + 20% spares)
- 31 VME crates $147K
- 31 MVME processors $118K

P.O. Exists

- Timing/diagnostics system $155K
- Analog filters $ 45K
- Cables and connectors $ 50K
- BLM interface electronic $ 18K

Design Or Estimate

In current wbs:

M&S = $1.76M + contingency + overhead

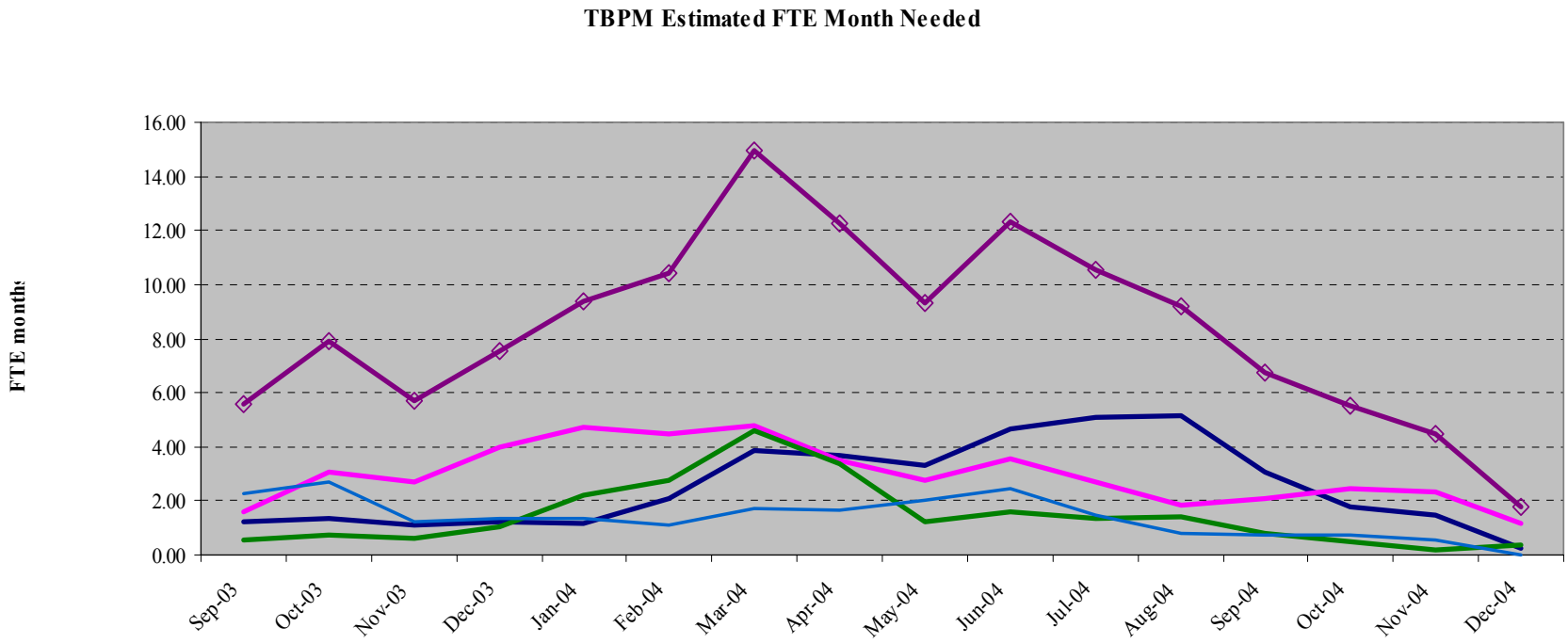
SWF = $1.06M + contingency + overhead

Project Planning – Schedule
DOE Milestones

- 9/22/03 Tev BPM Requirements Review
- 12/16/03 Tev BPM Technology Review
- 2/13/04 Core Electronics PO placed
- 4/1/04 First modified board delivered
- 4/28/04 Electronics system design review
- 6/1/04 First Production Board delivered
- 6/15/04 First crate in Tevatron
- 9/29/04 All Echotek boards delivered
- 10/19/04 System complete and cabled
- 10/19/04 TeV BPM Upgrade Operational

Total = 11.0 FTE-years

Not synchronized with shutdown/commissioning



	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
CP FTE	1.20	1.38	1.12	1.20	1.14	2.10	3.87	3.70	3.30	4.68	5.07	5.14	3.08	1.79	1.46	0.28
EE FTE	1.58	3.08	2.70	3.97	4.74	4.45	4.78	3.50	2.75	3.57	2.69	1.85	2.10	2.47	2.31	1.17
ET FTE	0.53	0.71	0.63	1.03	2.19	2.78	4.60	3.39	1.22	1.62	1.33	1.42	0.81	0.52	0.17	0.35
PHY FTE	2.28	2.72	1.24	1.32	1.32	1.09	1.73	1.65	2.02	2.45	1.46	0.77	0.74	0.74	0.53	0.00
FTE	5.58	7.88	5.69	7.52	9.39	10.42	14.97	12.23	9.29	12.32	10.53	9.18	6.73	5.51	4.46	1.80

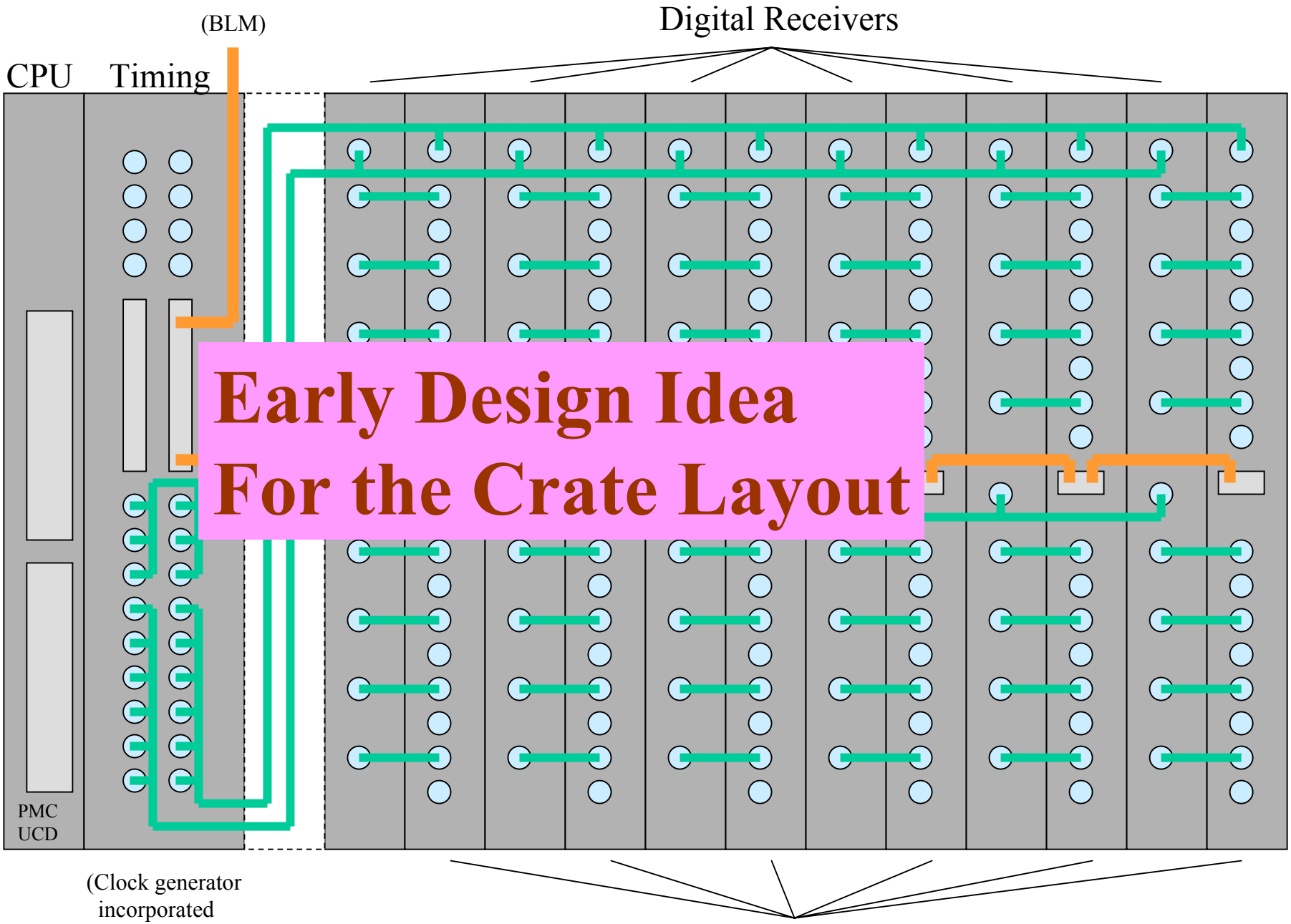
Effort Reports: 3.5 5.5 11.4 6.6 5.8 6.8

Recent Accomplishments

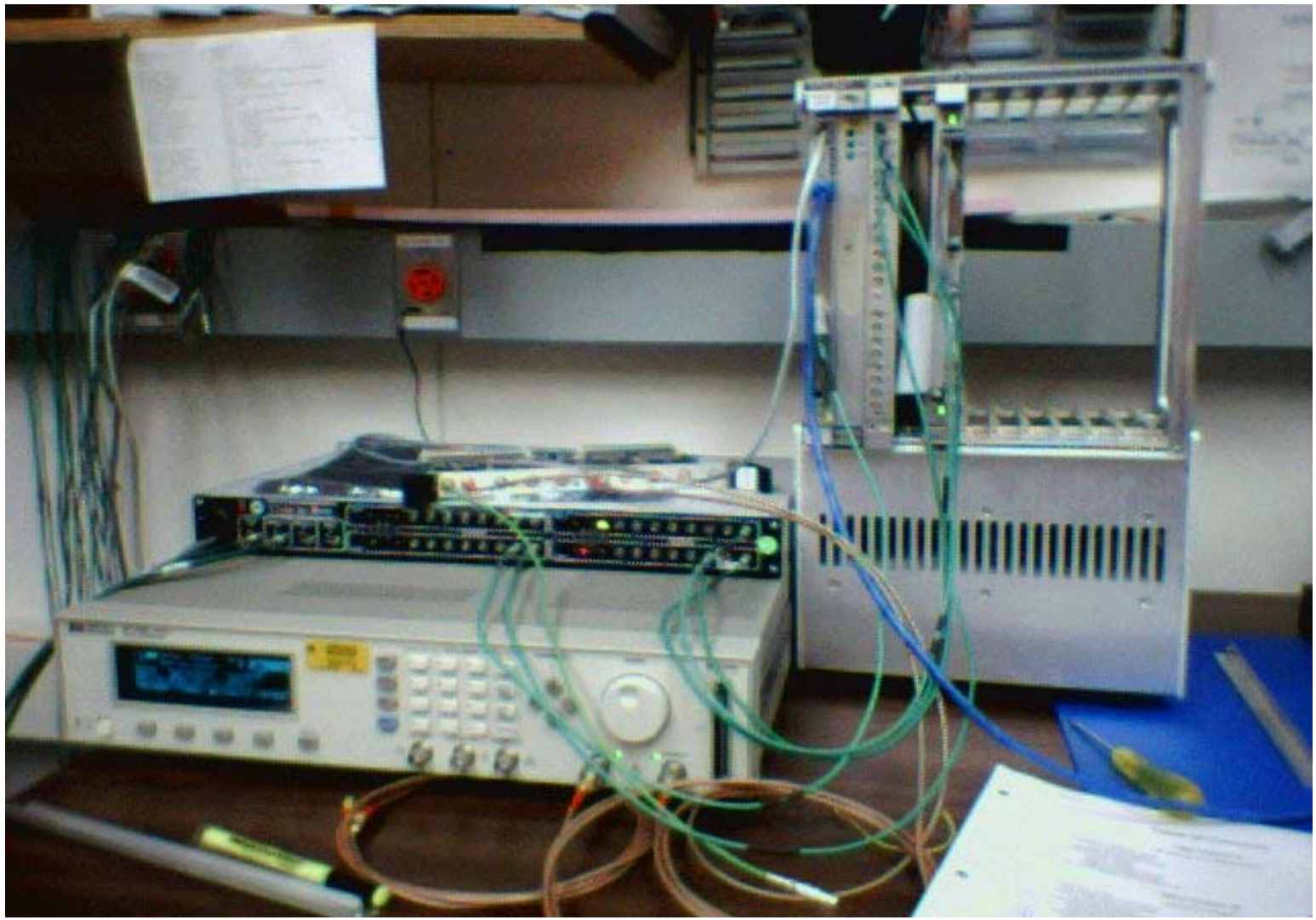
- RFP for core electronics (EchoTek or equivalent) went out 2/17/04.
  - Based on Recycler BPM electronics.
- Requisitions for MVME processors, VME crates are close to/will be placed soon.
- ➢ Cable work in the tunnel during the fall shutdown to enable readout of the p and pbar ends of each BPM (using MR cables).
- BLM (Beam Loss Monitor) interface electronics prototyping.
- ❖ Measurements in A1 from EchoTek and Damper Boards (Bob's talk).
- ❖ P/pbar separation studies (Bob's talk).
- Software specification for the DAQ, online and offline software is well-advanced or will be coming soon.
- ➢ Early design iterations of timing/diagnostics system.

Cables ready for electronics

BPM Pickup Ports In the tunnel


(BLM)
Digital Receivers
CPU
Timing
Early Design Idea
For the Crate Layout
PMC
UCD
(Clock generator
incorporated
in Timing board)
Diagnostics

Teststand in Feynman Computing Center



Installation and Commissioning

- A draft plan for checkout and installation and commissioning exists and has been discussed with the BPM project and the Tevatron Department.
- We will install service building by service building:
  - Implies a mix of old and new BPM's.
  - Don't want to transition all BPM's at once.
- Still to understand:
  - Board delivery schedule.
  - Shutdown schedule impact (can we pre-install when the beam is off?)

Issues/Concerns

- **Aggressive Timescale**
  - The plan is to have the system ready October 1, 2004.
  - We are working hard to install systems starting in June, 2004.
  - Using a similar system to the Recycler BPM readout will save valuable time.
  - It will be difficult to hold to this schedule but it is our goal and we will work hard to keep to the schedule.

Issues/Concerns (2)

- Technological Challenges
  - Pbar measurement
    - This is an important part of the system requirements
    - We are investigating how we can make the pbar position measurement
    - Ideas include frequency domain p-pbar subtraction, timing, wide-band hardware at key locations
      - (Bob's Talk)
  - Off-axis and other corrections
    - To make full advantage of the improved resolution (x10 or more) of this system corrections will have to be made, probably in the offline software.

Issues/Concerns (3)

- **Offline Applications**
  - We have to define the scope of the project with respect to offline applications.
  - A base set of libraries and applications will be part of this project.
  - Additional work would be the responsibility of the Tevatron department, the users of the system

Summary of part 1

- The Tevatron BPM Upgrade Project is a joint Accelerator Division-Computing Division Project and it is up and running.
- Our plan is to finish the design, acquire and install hardware and software, and hand off operations in 2004.
- Web page :

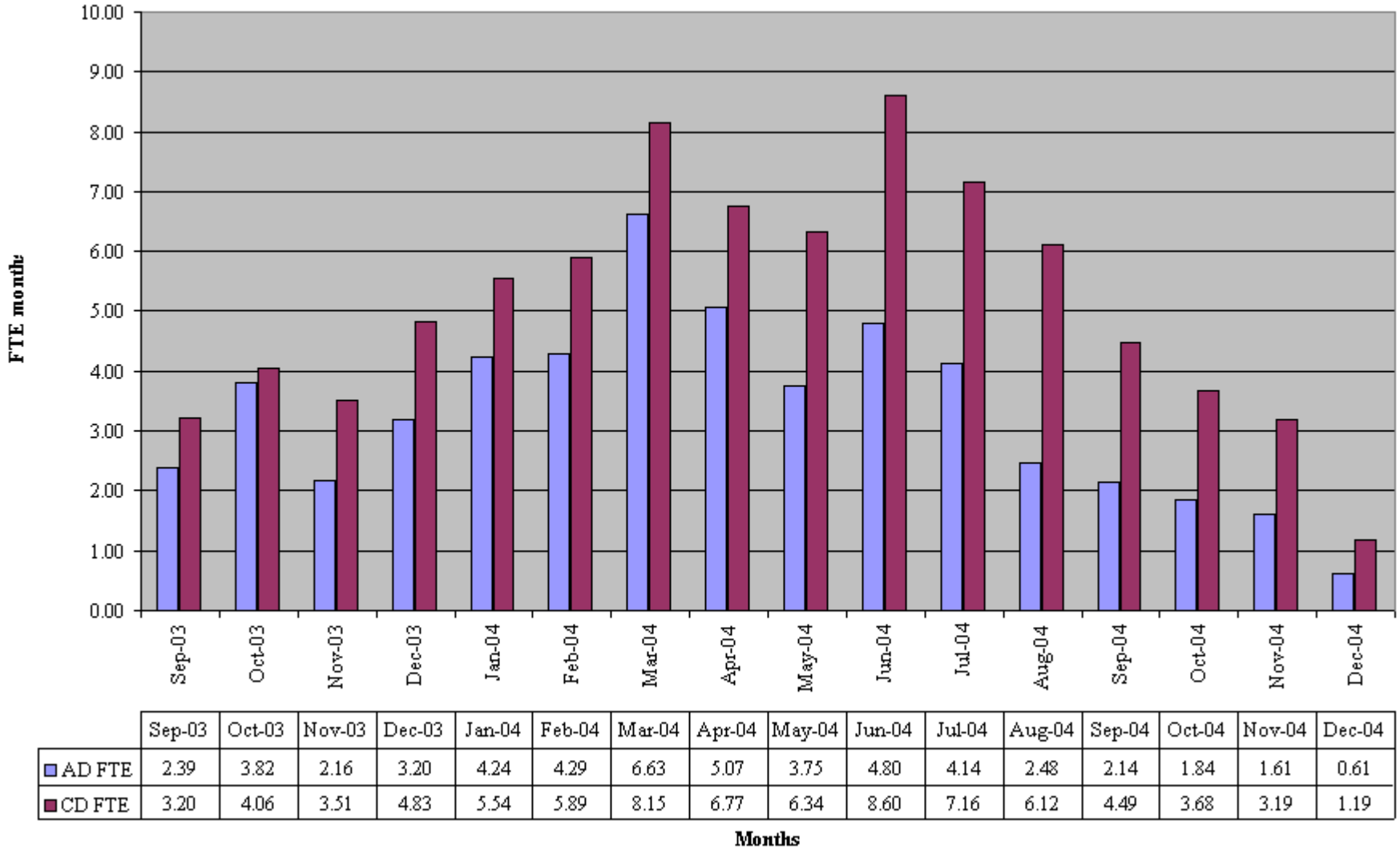
  http://projects.fnal.gov/tevbpm/

Backup Slides

26.4.6	Improved Control and Diagnostics	$2,609,753	$2,463,468	1/1/03	8/18/05
26.4.6.1	abort gap monitor	$31,452	$30,000	8/1/03	3/10/04
26.4.6.2	Tev Dampers	$55,057	$0	11/17/03	3/31/04
26.4.6.3	p/pbar Tune Tracker	$10,882	$30,000	11/3/03	5/21/04
26.4.6.4	Tevatron BPM Upgrade	$1,056,895	$1,764,018	9/2/03	12/9/04
26.4.6.5	Tevatron IPM	$449,286	$269,450	5/1/03	1/18/05
26.4.6.6	B-field diagnostics	$846,154	$40,000	1/1/03	12/16/04
26.4.6.7	1.7 GHz Schottky Detector	$65,154	$30,000	3/3/03	4/1/04
26.4.6.8	Head-tail Monitor	$0	$50,000	11/1/04	8/18/05
26.4.6.9	Tev BLM-Abort upgrade	$94,873	$250,000	2/2/04	9/29/04

26.4.6.4	**Tevatron BPM Upgrade**		
26.4.6.4.1.1.3.1.2	Core HW technical choice review complete	C	12/16/03
26.4.6.4.1.1.6	Electronics design review complete	C	4/30/04
26.4.6.4.2	Tev BPM: Requirements Review (Milestone)	C	9/22/03
26.4.6.4.3.1.2.1.2	Core electronics PO complete	C	2/13/04
26.4.6.4.3.1.2.1.4	Core electronics 1st modified board delivered	C	4/1/04
26.4.6.4.3.1.2.1.6	Core electronics 1st production board available	C	6/1/04
26.4.6.4.4.1.4	First production qualty crate available at Tevatron	C	6/15/04
26.4.6.4.4.2.2	Full system test complete	C	9/29/04
26.4.6.4.5.1.5	Electronics comissioning complete	C	10/19/04
26.4.6.4.6.9	Tev BPM Upgrade Operational	B	10/19/04

Current estimated effort for the Project by Division



	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
AD FTE	2.39	3.82	2.16	3.20	4.24	4.29	6.63	5.07	3.75	4.80	4.14	2.48	2.14	1.84	1.61	0.61
CD FTE	3.20	4.06	3.51	4.83	5.54	5.89	8.15	6.77	6.34	8.60	7.16	6.12	4.49	3.68	3.19	1.19

Cost, Schedule, Effort

- Reworked schedule from bottoms up:
  - Each subproject provided task and schedule estimates.
  - Rolled up and combined.
- Changes from last summer
  - Twice as many channels to measure p and pbar.
  - More knowledge of what Recycler BPM project took.
  - Software effort.
- From wbs
  - M&S: $1.76 million + contingency + overhead
  - SWF: $1.05 million + contingency + overhead

CD People Working on the Project

- Steve Wolbers, Bakul Banerjee, Judy Nicholls, Margaret Votava, Vince Pavlicek, Rob Kutschke, Mark Bowden, Bill Haynes, Luciano Piccoli, Dehong Zhang, Dinker Charak, Greg Duerling, Julia Yarba, Mark Fischler, Tom Boes, Mike Behnke, Bill Barker, Stu Bledsoe, …

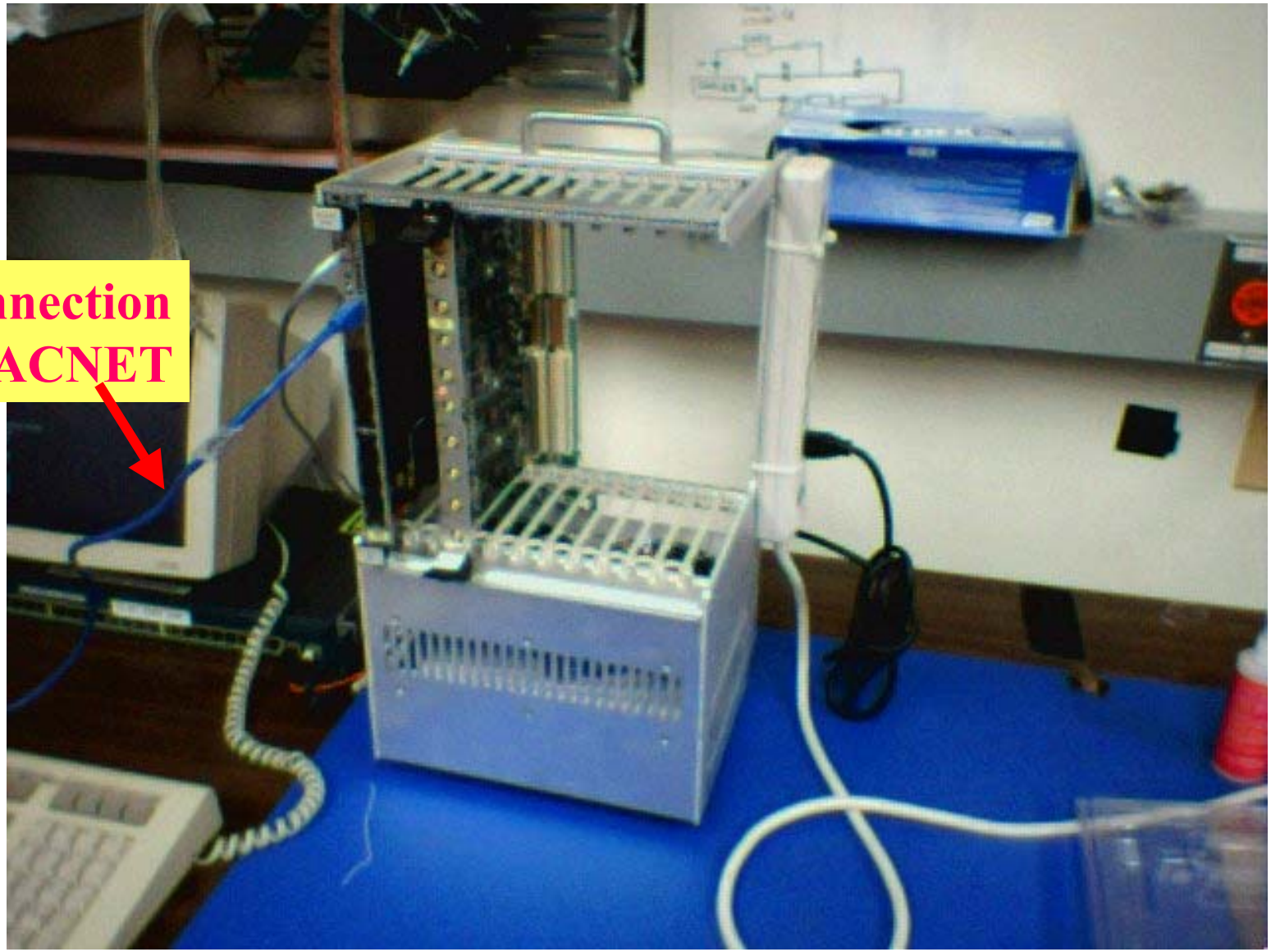
AD/PPD People Working on the Project

- Bob Webber, Jim Steimel, Mike Martens, Brian Hendricks, Jean Slaughter, Joel Butler, Stephen Pordes, Marv Olson, Ken Koch, Brian Chase, Duane Voy, Jim Patrick, Al Baumbaugh, Judy Sabo, Fritz DeJongh, Eric James, …

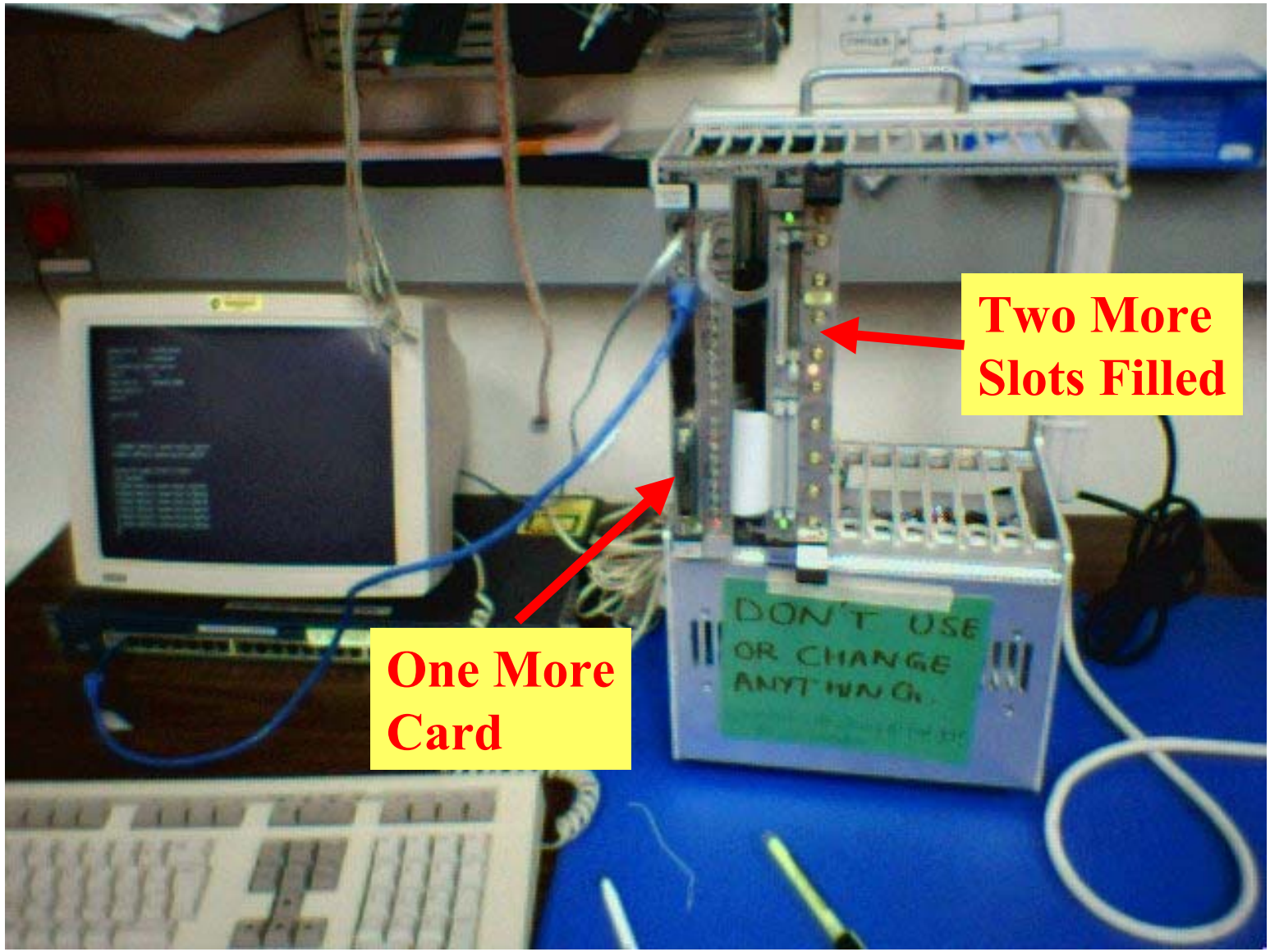
Test Stand in FCC

- Required ACNET and beam clock signals in FCC!
  - Thanks to CD Networking, Accelerator Division Controls and Networking, Margaret, Vince, others, it happened (and is still happening)
- The test stand will be an important part of the project, giving CD a dedicated place for tests (hardware and software)

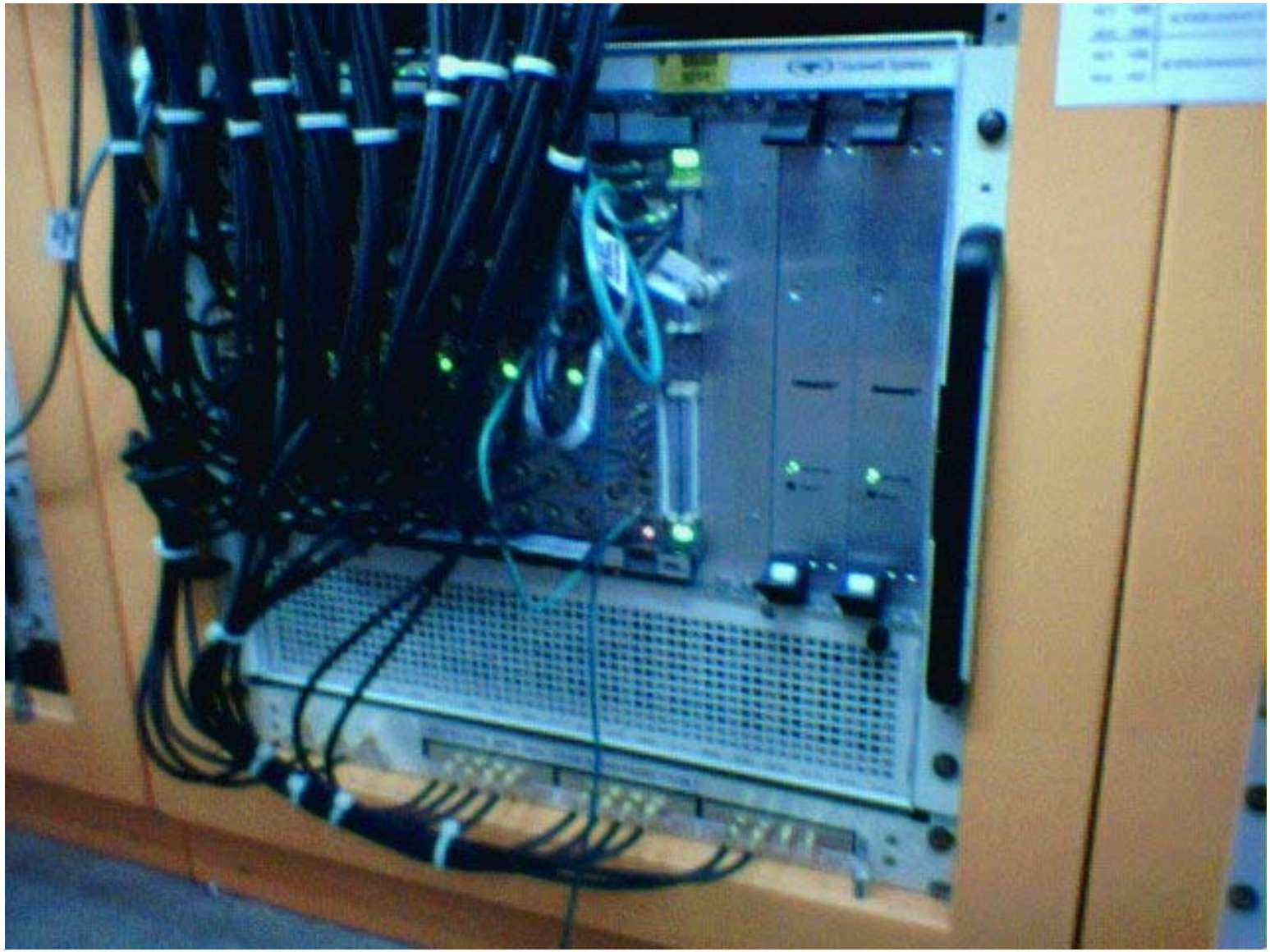
Test Stand in FCC3 – Last Week



Test Stand in FCC3 – This Week



Recycler Crate in AP60



Div	Name	Effort(%)			
		Oct	Nov	Dec	Jan
AD	Chase Brian		13	10	20
	Dejongh Fritz	50	20		
	Hendricks Brian	20	15	10	20
	Koch Ken	100	0		
	Martens M.	20	20	20	20
	McCormick Jim	100	0		
	Olson Marv	90	0		
	Sabo Judy	100	0		
	Steimel J.	75	75	70	80
	Webber Bob	20	20	30	50
	Total AD FTE	575	163	140	
CD	BANERJEE	52	85	75	
	BARKER	75	0	0	
	BEHNKE	25	0	0	
	BLEDSOE	70	0	0	
	BOES	40	0	0	
	BOWDEN	25	30	25	
	CHARAK	0	20	6	
	DUERLING	0	0	10	
	FISCHLER	0	0	7	
	KUTSCHKE	60	60	35	
	NICHOLS	16	13	8	
	PAVLICEK	20	20	30	
	PICCOLI	60	65	60	
	VOTAVA	45	50	30	
	WOLBERS	50	50	50	
	YARBA		50	25	
	ZHANG	65	60	75	
	Total CD FTE	603	503	436	
	Total FTE	11.78	6.66	5.76	

Issues/Concerns(2)

- Long Timescale
  - Summer/fall shutdown may have an impact on commissioning
  - The draft commissioning plan does not allow commissioning during the shutdown.
    - This implies that the project will extend into late 2004/early 2005.
  - Other aspects of the project also will drive us to longer times
    - Full system commissioning
    - Application software
    - Full documentation

Issues/Concerns (5)

- More BPMs (Main Injector, Transfer Lines)
  - The TeV BPM project has in its scope only the Tevatron BPMs (240)
  - The Main Injector and Transfer lines could use the same system.
  - There currently is no project organized to design and build those other systems.
  - There is some desire to continue this project to complete the other BPMs.

Partial Project History

- Steve Wolbers joined the effort as Project Manager in mid-July, 2003.
  - This is the "project start" as far as I am concerned.
  - Lots of work was done prior to that time by many people and that should not be forgotten.
- August-September was spent getting "up to speed":
  - Most of us are not accelerator instrumentation experts
  - There was a need to talk the same language, understand the same concepts
  - There was also a large amount of vacation to deal with in this time-frame.

Partial Project History (2)

- September-December: serious planning and analysis toward picking a hardware solution and understanding the needs of the system.
- December-Now: Design, requisition writing, prototype measurements, test stands, etc.

BLM PO complete	A	$0	$16,965		
Core electronics PO complete	A	$0	$1,022,400		
Timing card PO complete	A	$0	$75,400		
BPM Calibration Card		$22,481	$109,340		
BPM consolidated crate PO complete	A	$0	$436,940		
Electronics fabrication		$138,146	$1,661,045	In WBS	$1,661,045
Tunnel			$102,973		
Tevatron BPM Upgrade		$1,047,745	$1,764,018		